Complete Summary

GUIDELINE TITLE

ACR Appropriateness Criteria® acute chest pain - low probability of coronary artery disease.

BIBLIOGRAPHIC SOURCE(S)

Stanford W, Yucel EK, Khan A, Atalay MK, Haramati LB, Ho VB, Mammen L, Rozenschtein A, Rybicki FJ, Schoepf UJ, Stein B, Woodard PK, Jaff M, Expert Panel on Cardiac Imaging. ACR Appropriateness Criteria® acute chest pain--low probability of coronary artery disease. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 4 p. [31 references]

GUIDELINE STATUS

This is the current release of the guideline.

This guideline updates a previous version: Stanford W, Yucel EK, Bettmann MA, Casciani T, Gomes AS, Grollman JH, Holtzman SR, Polak JF, Sacks D, Schoepf J, Jaff M, Moneta GL, Expert Panel on Cardiovascular Imaging. Acute chest pain: no ECG or enzyme evidence of myocardial ischemia/infarction. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 5 p.

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Acute chest pain with low probability of coronary artery disease (CAD)

GUIDELINE CATEGORY

Diagnosis
Evaluation

CLINICAL SPECIALTY

Cardiology
Emergency Medicine
Family Practice
Internal Medicine
Nuclear Medicine
Radiology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for patients with acute chest pain with low probability of coronary artery disease (CAD)

TARGET POPULATION

Patients with acute chest pain with low probability of coronary artery disease (CAD)

Note: Patients with signs and/or symptoms of acute coronary syndrome (ACS) are not included in this discussion as the evaluation and treatment algorithms have been well defined in the Scientific Statements and Practice Guidelines of the American Heart Association.

INTERVENTIONS AND PRACTICES CONSIDERED

1. X-ray
    - Chest
    - Barium swallow and upper gastrointestinal (GI) series
    - Rib views
    - Thoracic spine
2. Computed tomography (CT), coronary calcium
3. CT angiography (CTA)
    - Coronary arteries
    - Chest (noncoronary)
4. Magnetic resonance imaging (MRI), heart, with stress, with or without contrast
5. Magnetic resonance angiography (MRA)
    - Chest (noncoronary)
    - Pulmonary arteries

- Coronary arteries

6. Ultrasound (US)
    - Transthoracic echocardiography
    - Transesophageal echocardiography
    - Transthoracic stress echocardiography
    - Abdomen
7. Nuclear medicine (NUC)
    - Myocardial perfusion scan
    - Technetium (Tc)-99m ventilation/perfusion (V/Q) scan, lung
8. Invasive (INV), coronary angiography with ventriculography

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of peer-reviewed medical journals, and the major applicable articles were identified and collected.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1–9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria®

Clinical Condition: Acute Chest Pain -- Low Probability of Coronary Artery Disease

Radiologic Procedure	Rating	Comments	RRL*
X-ray chest	9		Min
NUC myocardial perfusion scan	8	If a cardiac etiology is suspected.	High
CTA coronary arteries	7	If a cardiac etiology is suspected.	High
MRI heart with stress with or without contrast	7	If local expertise is available. See comments regarding contrast in the text below under "Anticipated Exceptions."	None
CTA chest (noncoronary)	6	Useful in ruling out other causes of chest pain such as aortic dissection, pulmonary embolism, pneumothorax, pneumonia.	Med
US echocardiography transthoracic	6	If a cardiac etiology is suspected.	None
US echocardiography transesophageal	6	If a cardiac etiology is suspected. To exclude aortic dissection if MDCT and/or MRI are nondiagnostic.	None
MRA chest (noncoronary)	5	Alternative to MDCT if aortic dissection is suspected. See comments regarding contrast in the text below under "Anticipated Exceptions."	None
NUC Tc-99m V/Q scan lung	5	If contrast administration is contraindicated and pulmonary embolism is suspected.	Med
MRA pulmonary arteries	4	If local expertise is available. See comments regarding contrast in the text below under "Anticipated Exceptions."	None

Radiologic Procedure	Rating	Comments	RRL*
US echocardiography transthoracic stress	4	Alternative to stress nuclear medicine scan if cardiac etiology is suspected.	None
INV, coronary angiography with ventriculography	4	If stress testing is equivocal and a cardiac etiology is suspected.	Med
CT coronary calcium	4	A negative score may be useful for ruling out coronary etiology.	Med
X-ray barium swallow and upper GI series	3	If gastroesophageal disease is suspected.	Med
X-ray rib views	3	If a chest wall etiology is suspected.	Med
X-ray thoracic spine	3	If a spinal etiology is suspected.	Med
US abdomen	3	If abdominal pathology is suspected.	None
MRA coronary arteries	2	Not well developed.	None
Rating Scale: 1=Least appropriate, 9=Most appropriate			***Relative Radiation Level**

Note: Abbreviations used in the table are listed at the end of the "Major Recommendations" field.

Summary of Literature Review

Patients with signs and/or symptoms of acute coronary syndrome (ACS) are not included in this discussion as the evaluation and treatment algorithms have been well defined in the Scientific Statements and Practice Guidelines of the American Heart Association. The classic patient with suspected ACS presents to emergency departments with substernal chest pain, diagnostic ST segment changes, and elevated cardiac enzymes suggesting myocardial infarction. For those patients who do not present with classic ACS signs, symptoms, or electrocardiogram (ECG) abnormalities the differential diagnosis needs to include pulmonary, gastrointestinal (GI), or musculoskeletal pathologies. In these patients, noninvasive imaging methodologies are essential for diagnosis.

The following imaging modalities are available in evaluating patients presenting to the emergency departments with low probability of coronary artery disease (CAD): chest radiography, multidetector computed tomography (MDCT), magnetic resonance imaging (MRI), ventilation/perfusion (V/Q) scans, cardiac perfusion scintigraphy, transesophageal and transthoracic echocardiography, positron

emission tomography (PET), spine and rib radiography, barium esophageal and upper GI studies, and abdominal ultrasound.

Chest Radiography

The chest radiograph is the recommended initial imaging study. Chest radiographs can diagnose pneumothorax, pneumomediastinum, fractured ribs, acute and chronic infections, and malignancies. Other conditions producing chest pain, such as aortic aneurysms/dissections and/or pulmonary emboli, may be suspected from the chest radiograph, but the overall sensitivities are less.

Thoracic calcifications, if present, may indicate pericardial disease, ventricular aneurysm, intracardiac thrombi, or aortic disease. The presence of a Hampton hump, Westermark sign, or pulmonary artery enlargement may suggest pulmonary embolism, while mediastinal air may indicate a ruptured viscus or subpleural bleb.

Multidetector Computed Tomography

MDCT has very high accuracy in demonstrating pneumothorax, pneumonia, malignancies, and pulmonary airspace disease. CT angiography (CTA) is the imaging modality of choice for suspected pulmonary embolism and aortic pathology such as dissection or aneurysm. Pericardial effusions, thickening, and/or calcifications are seen far more readily than with radiographs alone. Electrocardiogram (ECG) gated MDCT can be used in dedicated cardiac protocols for coronary CTA. This examination has a very high negative predictive value for CAD. When coronary CTA is performed with retrospective ECG-gating, wall motion and valve abnormalities can be identified via cine evaluations of CT images acquired throughout the cardiac cycle. Both prospective and retrospective ECG-gated cardiac CT can define ventricular aneurysms and cardiac thrombi. MDCT is also the primary method for diagnosing coronary anomalies. A coronary calcium score of zero can be useful in excluding CAD.

Transthoracic and Transesophageal Echocardiography

Transthoracic and transesophageal echocardiography with or without pharmacologic stress are frequently used to define abnormalities of ventricular wall motion as an indicator of cardiac disease. In addition, echocardiography can readily demonstrate pericardial effusion, valve dysfunction, and cardiac thrombus. Aortic pathology can be identified, but the findings of intramural hematoma, dissection, pulmonary embolus, and aneurysm are better seen with MDCT or MRI (discussed below).

Magnetic Resonance Imaging

Magnetic resonance angiography (MRA) can be performed with either noncontrast (e.g., time-of-flight, balanced gradient-echo) or contrast-enhanced (e.g., 3D arterial-phase fast gradient-echo) protocols that are useful in identifying vascular pathology. These techniques can be used to identify aortic as well as pulmonary artery pathology. MRA is typically more time-consuming and less available in the emergency setting, but is an important alternative noninvasive imaging strategy

in patients with a contraindication to CTA. Cardiac MRI is uncommonly used in the emergency setting because of the relatively long scan times and the limited number of trained physicians, technologists, and MR resources.

Radiography of the Ribs, Cervical Spine, or Thoracic Spine

Rib or spine radiographs are indicated in patients with a clinical suspicion of skeletal pathology.

Radionuclide Studies

Radionuclide myocardial perfusion studies with thallium 201, technetium 99m sestamibi, or tetrofosmin are frequently used in identifying perfusion abnormalities as a cause for the chest pain, especially when a cardiac etiology is suspected. A normal stress perfusion scan may be used to exclude the diagnosis of coronary artery disease in patients who have ruled out myocardial infarction by enzymes.

PET is an alternative method for evaluating myocardial perfusion deficits, using N13 ammonia or rubidium 82 agents. However, these examinations are less commonly used because they are time consuming and resources are not readily available.

V/Q lung scintigraphy can be used in patients with clinically suspected pulmonary embolism, but this study has been largely replaced by MDCT.

Cardiac Catheterization

Cardiac catheterization with coronary digital subtraction angiography remains the gold standard in demonstrating CAD and can permit immediate therapeutic intervention. Catheterization has traditionally served as the definitive diagnostic test, although the high negative predictive value of coronary CTA enables it to be used alone to exclude CAD.

Barium Swallow or Endoscopy

Esophageal disorders can be the cause of chest pain. A barium swallow or endoscopy may be helpful in establishing esophageal spasm or reflux as an etiology of the chest pain.

Abdominal Ultrasonography

Abdominal ultrasound may be indicated in documenting cholecystitis as a cause for the chest pain. Ultrasound is also helpful in evaluating pancreatitis and/or intra-abdominal abscesses and fluid collections.

Summary

The patient's history is important in establishing the etiology in patients presenting to the emergency departments with a low probability of a cardiac etiology for their chest pain, and a number of imaging modalities may be required

to establish the diagnosis. The chest radiograph is almost universally obtained. Traditionally, cardiac echo, stress perfusion scanning, and coronary angiography have been the mainstays for diagnosing coronary heart disease. MDCT is increasingly used in the evaluation of coronary disease. CTA, MRA, ventilation-perfusion scanning, barium swallow, and spine or rib radiographs play a role in evaluating noncoronary causes of chest pain.

Anticipated Exceptions

Nephrogenic systemic fibrosis (NSF, also known as nephrogenic fibrosing dermopathy) was first identified in 1997 and has recently generated substantial concern among radiologists, referring doctors and lay people. Until the last few years, gadolinium-based MR contrast agents were widely believed to be almost universally well tolerated, extremely safe and non-nephrotoxic, even when used in patients with impaired renal function. All available experience suggests that these agents remain generally very safe, but recently some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed NSF, a syndrome that can be fatal. Further studies are necessary to determine what the exact relationships are between gadolinium-containing contrast agents, their specific components and stoichiometry, patient renal function and NSF. Current theory links the development of NSF to the administration of relatively high doses (e.g., >0.2mM/kg) and to agents in which the gadolinium is least strongly chelated. The U.S. Food and Drug Administration (FDA) has recently issued a "black box" warning concerning these contrast agents (http://www.fda.gov/Drugs/DrugSafety/PostmarketDrugSafetyInformationforPatientsandProviders/ucm142882.htm).

This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated glomerular filtration rate [GFR] <30 mL/min/1.73m^2), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s).

Abbreviations

- CT, computed tomography
- CTA, computed tomography angiography
- GI, gastrointestinal
- INV, invasive
- MDCT, multidetector computed tomography
- Med, medium
- Min, minimal
- MRA, magnetic resonance angiography
- MRI, magnetic resonance imaging
- NUC, nuclear medicine
- Tc, technetium
- US, ultrasound
- V/Q, ventilation/perfusion scan

Relative Radiation Level	Effective Dose Estimated Range
None	0
Minimal	<0.1 mSv
Low	0.1-1 mSv
Medium	1-10 mSv
High	10-100 mSv

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Selection of appropriate radiologic imaging procedures for evaluation of patients with acute chest pain with low probability of coronary artery disease (CAD)

POTENTIAL HARMS

Some patients with renal failure who have been exposed to gadolinium contrast agents (the percentage is unclear) have developed nephrogenic systemic fibrosis (NSF), a syndrome that can be fatal. The U.S. Food and Drug Administration (FDA) has recently issued a "black box" warning concerning these contrast agents. This warning recommends that, until further information is available, gadolinium contrast agents should not be administered to patients with either acute or significant chronic kidney disease (estimated glomerular filtration rate [GFR] <30 mL/min/1.73m^2), recent liver or kidney transplant or hepato-renal syndrome, unless a risk-benefit assessment suggests that the benefit of administration in the particular patient clearly outweighs the potential risk(s).

Relative Radiation Level (RRL)

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level indication has been included for each imaging examination. The RRLs are based on effective dose, which is a

radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Additional information regarding radiation dose assessment for imaging examinations can be found in the American College of Radiology (ACR) Appropriateness Criteria® Radiation Dose Assessment Introduction document (see "Availability of Companion Documents" field).

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Stanford W, Yucel EK, Khan A, Atalay MK, Haramati LB, Ho VB, Mammen L, Rozenschtein A, Rybicki FJ, Schoepf UJ, Stein B, Woodard PK, Jaff M, Expert Panel on Cardiac Imaging. ACR Appropriateness Criteria® acute chest pain--low probability of coronary artery disease. [online publication]. Reston (VA): American College of Radiology (ACR); 2008. 4 p. [31 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1998 (revised 2008)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

GUIDELINE COMMITTEE

Committee on Appropriateness Criteria, Expert Panel on Cardiac Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: William Stanford, MD; E. Kent Yucel, MD; Arfa Khan, MD; Michael K. Atalay, MD, PhD; Linda B. Haramati, MD; Vincent B. Ho, MD, MBA; Leena Mammen, MD; Anna Rozenshtein, MD; Frank J. Rybicki, MD, PhD; U. Joseph Schoepf, MD; Barry Stein, MD; Pamela K. Woodard, MD; Michael Jaff, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

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The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

ACR Appropriateness Criteria® *Anytime*, *Anywhere*™ (PDA application). Available from the ACR Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

The following are available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.
- ACR Appropriateness Criteria® radiation dose assessment introduction. American College of Radiology. 2 p. Electronic copies: Available from the American College of Radiology Web site.

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on February 20, 2001. The information was verified by the guideline developer on March 14, 2001. This summary was updated by ECRI on July 31, 2002. The updated information was verified by the guideline developer on October 1, 2002. This summary was updated by ECRI on March 17, 2006. This summary was updated by ECRI Institute on July 12, 2007 following the U.S. Food and Drug Administration (FDA) advisory on Troponin-1 Immunoassay. This NGC summary was completed by ECRI Institute on September 9, 2009.

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